

Executive Summary

North Coast Watershed Assessment Program

The North Coast Watershed Assessment Program (NCWAP) is an interagency effort between the California Resources Agency and CalEPA, established to provide a consistent body of information on North Coast watersheds for use by landowners, stakeholders, and collaborative watershed groups. The program's work is intended to provide answers to the following assessment questions at the basin and subbasin scales in California's North Coast watersheds:

- What are the history and trends of the size, distribution, and relative health and diversity of salmonid populations?
- What are the current salmonid habitat conditions? How do these conditions compare to desired conditions?
- What are the past and present relationships of geologic, vegetative, and fluvial processes to stream habitat conditions?
- How has land use affected these natural processes?
- Based upon these conditions, trends, and relationships, are there elements that could be considered to be limiting factors for salmon and steelhead production?
- What watershed and habitat improvement activities would most likely lead toward more desirable conditions in a timely, cost effective manner?

To help answer these questions, the basin assessment has been designed to meet these strategic program goals:

- Organize and provide existing information and develop limited baseline data to help evaluate the effectiveness of various resource protection programs over time;
- Provide assessment information to help focus watershed improvement programs, and assist landowners, local watershed groups, and individuals to develop successful projects. This will help guide support programs, like CDFG's Fishery Restoration Grants Program, toward those watersheds and project types that can efficiently and effectively improve freshwater habitat and lead to improved salmonid populations;
- Provide assessment information to help focus cooperative interagency, nonprofit, and private sector approaches to protect the best watersheds and streams through watershed stewardship, conservation easements, and other incentive programs;
- Provide assessment information to help landowners and agencies better implement laws that require specific assessments such as the State Forest Practice Act, Clean Water Act, and State Lake and Streambed Alteration Agreements.

The NCWAP program was established by the California Resources Agency and the California Environmental Protection Agency, and developed by the Departments of Fish and Game (CDFG), Forestry and Fire Protection (CDF), Conservation/California Geologic Survey (DOC/CGS), and Water Resources (DWR), in conjunction with the North Coast Regional Water Quality Control Board (NCRWQCB) and State Water Resources Control Board. The Institute for Fisheries Resources (IFR) is also a partner and participant in this program.

Salmonids, Habitat, & Land Use Relationships

There are several factors necessary for the successful completion of an anadromous salmonid's life history. In the freshwater phase of the life history, stream connectivity, stream condition, and riparian function are essential for survival. Stream connectivity describes the absence of barriers to the free instream movement of adult and juvenile salmonids. Stream condition includes several factors: adequate stream flow, suitable water quality, appropriate stream temperature, and complex, diverse habitat.

Adequate instream flow during low flow periods is essential for good summer time stream connectivity, and is necessary to provide juvenile salmonids free forage range, cover from predation, and utilization of localized temperature refugia from seeps, springs, and cool tributaries. Three important aspects of water quality for anadromous salmonids are water temperature, turbidity, and sediment load. Habitat diversity for salmonids is created by a combination of deep pools, riffles, and flatwater habitat types.

Geology, climate, watershed hydrologic responses, and erosion events interact to shape freshwater salmonid habitats of the Mattole Basin. “In the absence of major disturbance, these processes produce small but virtually continuous changes in variability and diversity against which the manager must judge the modifications produced by nature and human activity. Major disruption of these interactions can drastically alter habitat conditions” (Swanston, 1991). Major watershed disruptions can be caused by catastrophic events, such as the 1955 and 1964 floods or major earthquakes. They can also be created over time by multiple small natural and/or human disturbances.

A functional riparian zone helps to control the amount of sunlight reaching the stream, and provides vegetative litter and invertebrate fall. These contribute to the production of food for the aquatic community, including salmonids. Tree roots and other vegetative cover provide stream bank cohesion and buffer impacts from adjacent uplands. Near stream vegetation eventually provides large woody debris and complexity to the stream (Flosi et al. 1998).

A main component of the NCWAP is the analysis of these stream and watershed factors to identify whether any of them are at a level that limits production of anadromous salmonids in North Coast watersheds. A limiting factor can be anything that constrains, impedes, or limits the growth and survival of a population. This limiting factors analysis (LFA) provides a means to evaluate the status of key environmental factors that affect anadromous salmonid life history. This information will be useful to identify the underlying causes of stream habitat deficiencies and help reveal if there is a linkage to watershed processes and land use activities.

Mattole Basin

The Mattole Basin encompasses approximately 296 square miles of Northern California’s Coast Range (Figure 1). Although nearly three percent of the Mattole’s headwaters are in Mendocino County; the vast majority of the basin is within Humboldt County. The mainstem Mattole River is approximately 62 miles long, and receives water from over 74 tributary streams. There are approximately 545 perennial stream miles in the basin. The basin drains into the Pacific Ocean just south of Cape Mendocino. Elevation within the basin ranges from sea level at the estuary to 4,088 feet at Kings Peak.

The word Mattole meant “clear waters” in the language of the Athabaskan-speaking Mattole and Sinkiyone Native Americans. Little is known about these Native Americans, for they were quickly displaced by settlers from the Eastern United States, who arrived in the early 1850s. Based upon the practices of other North Coast native peoples, it is presumed they utilized abundant, native salmon and steelhead resource for an important component of their sustenance.

The Mattole Basin has a Mediterranean climate characterized by cool wet winters with high runoff, and dry warm summers with greatly reduced flows. The basin receives one of the highest amounts of annual rainfall in California, averaging 81 inches. Along the coast, average air temperatures range from 46°F to 56°F. Further inland, annual air temperatures are much more varied, ranging from below freezing in winter to over 100° F in summer.

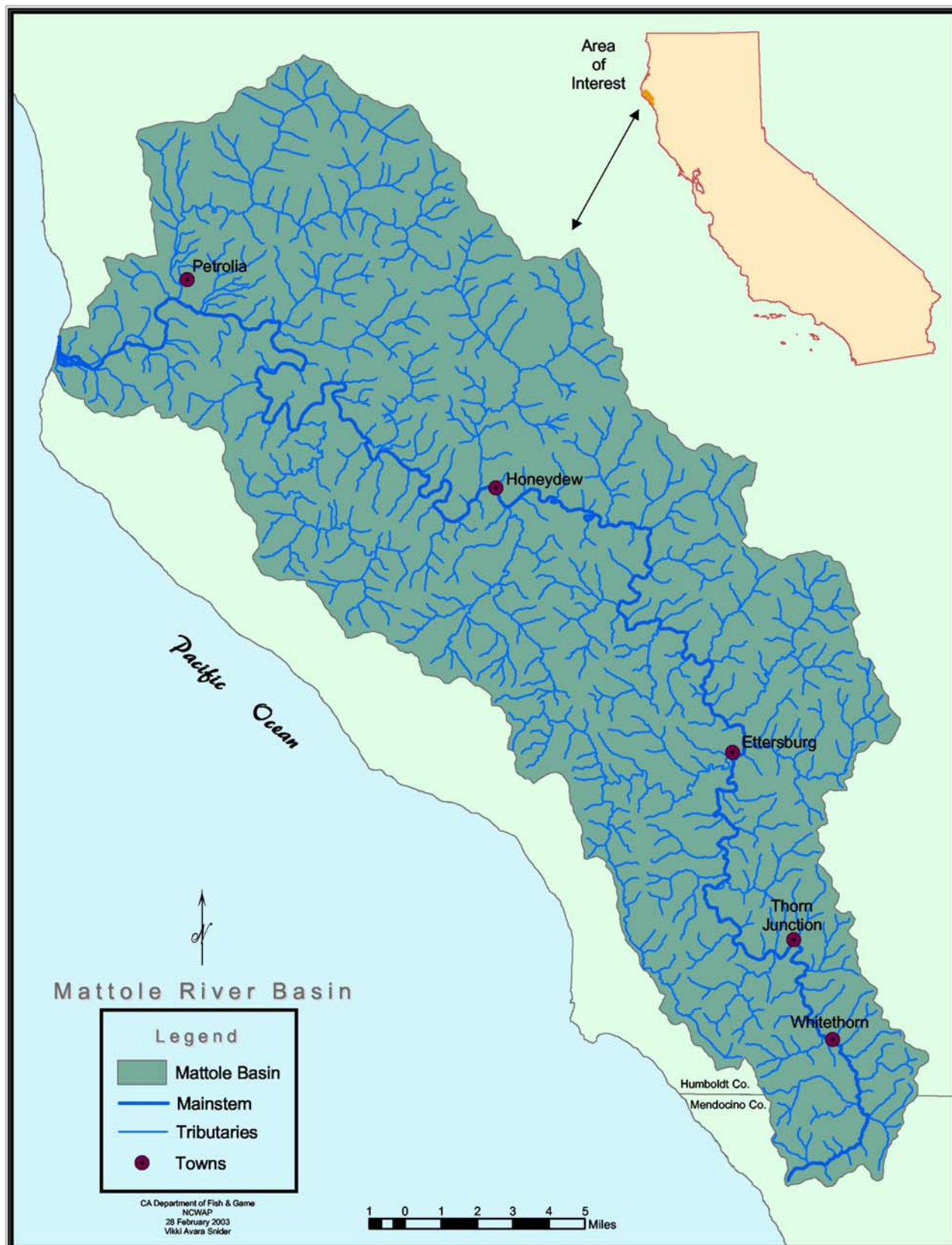


Figure 1. Mattole Basin streams and towns.

The Mattole Basin is located in a complex tectonic setting near the junction of three crustal plates. This region experiences a high level of seismic activity, and major earthquakes have occurred in intraplate areas as well as along well defined faults (Dengler et al. 1992). Bedrock underlying much of the basin has been tectonically broken and sheared making it relatively weak, easily weathered, and inherently susceptible to landsliding and erosion. Certain identifiable portions of the bedrock are more susceptible than others. The unstable bedrock and soil conditions combined with heavy rainfall, high regional uplift rates, and very active seismicity produce widespread naturally-occurring landsliding with associated large volumes of sediment input to streams.

The current vegetation in the Mattole Basin is predominately forestland, although some localized areas are covered primarily by grasslands. Mixed conifer and hardwood forestland occupy 57% of the basin while hardwood forests occupy 17% and coniferous forests occupy another 8%. Annual grasslands occupy 15% of the basin. All other vegetation types occupy the remaining three percent of the basin. The Mattole Basin is unusual within the Northern California coast as having very little redwood forest present; this is thought to be primarily due to the King Range blocking the summer fog needed to stimulate the growth of redwoods.

The total Mattole Basin resident population for the year 2000 census was estimated to be about 1,200 people. Eighty-four percent of the basin is held and managed as private property. In 1941 air photos, the most widespread land use of the basin appears to have been grazing. Timber harvest operations began in earnest during the post World War II boom. By the late 1970s, timber harvesting had decreased to very low levels of production. Meanwhile, environmental awareness had increased among many residents of the Mattole Basin and the North Coast in general. Changes in policy concerning management of federal lands and the designation of the Northern Spotted Owl as federally threatened led to the designation of Bureau of Land Management (BLM) lands within the Mattole Basin as Late Succession Reserve lands that are not subject to timber harvest (BLM, Bear Creek Report 1995). The BLM ownership comprises 15% of the Mattole Basin so their management is very significant to the basin's resources.

Fishery resources of the Mattole Basin include fall-run Chinook salmon, coho salmon, summer-run steelhead trout, and winter-run steelhead trout. The salmon and steelhead trout have been traditionally important as food and recreation resources to local residents and visitors. Though anecdotal evidence provides a convincing case that historic anadromous salmonid runs in the Mattole Basin were large and there has been a sharp decline in the size of these runs since the mid 1950s, little quantitative historic data exist (BLM, 1996).

An estimate of Chinook salmon, coho salmon, and steelhead trout populations in the Mattole Basin was made by the United States Fish and Wildlife Service (USFWS) in 1960. Their estimates were based upon spawner surveys and interviews with sportsmen and local residents. From these two sources, Mattole Basin population estimates of 2,000 Chinook salmon, 5,000 coho salmon and 12,000 steelhead trout were made. Additionally, potential population estimates were projected based on the capacity of surveyed spawning reaches with suitable gravel. Potential populations of 7,900 pairs of Chinook salmon, 10,000 pairs of coho salmon and 10,000 pairs of steelhead trout were estimated.

Recent accounts from Mattole Basin anglers who fished in the 1945 – 1970 time period describe a fabled sport fishery where in good stream conditions a group of four or five anglers could expect to hook and release over a hundred fish, mostly steelhead, in a day of fishing (J. Clary, personal communication). Also, salmon poaching beneath the Petrolia Bridge, and elsewhere, provided a viable means of making a little Christmas money by selling fresh and smoked salmon as late as the 1960s (C. Wright, personal communication).

In 1965, the year following the second major flood event in ten years, the Department of Water Resources (DWR) speculated that there had been a significant reduction in the size of Mattole Basin anadromous fish runs. They felt this was a result of large increases in siltation and debris jams following land disturbance from intensive logging that started in 1950, coupled with the two major flood events. The fisheries began steady declines in the 1960s.

By the late 1970s, fish populations had collapsed to levels that alerted locals to their depressed condition. Local watershed groups, the BLM, various state agencies such as CDFG, and local landowners have worked on numerous restoration projects throughout the Mattole Basin. The Mattole Restoration Council (MRC) and the Mattole Salmon Group (MSG) have obtained contracts for work on such diverse areas of

restoration as stream surveys, road assessment, re-vegetation, instream habitat improvement, fish rearing, public education, and monitoring.

Mattole Basin General Issues

Public scoping meetings, workshops with Mattole Basin residents and constituents, and initial analyses of available data by watershed experts developed this working list of general issues and/or concerns:

- Sediment, temperature, pool habitat, escape and ambush cover, and substrate embeddedness in the estuary are thought to be outside of supportive levels for salmonids in the estuary;
- Predation upon depressed fish populations by birds and mammals in the estuary;
- Excessive extraction of water during low flow periods;
- Artificial fish passage barriers exist at some road crossings of streams;
- Abandoned roads, new road construction, and road maintenance issues related to landsliding and sediment input to streams;
- High water temperatures;
- Pollutant spills, such as some recent bulk diesel spills into tributaries;
- Herbicides used on industrial timberlands;
- Location and conduct of timber harvest operations;
- Sub-division development and construction;
- Low stream habitat diversity and complexity;
- Low stream shade canopy cover;
- Large woody debris recruitment to streams;
- Absence of salmonid information, low fish densities, or absences of fish;
- Access for agency personnel to private land for field studies.

General Assessment Approach

Each of the NCWAP's participating departments developed data collection and analysis methods used in their basin assessments. They also developed a number of tools for interdisciplinary synthesis of collected information. These included models, maps, and matrices for integrating information on basin, subbasin, and stream reach scales to explore linkages among watershed processes, conditions, and use. These tools provided a framework for identifying watershed refugia areas and factors limiting salmonid productivity, as well as providing a basis for understanding the potential for cumulative impacts from natural and man caused impacts. This information provided guidance for developing restoration, management, and conservation recommendations.

The roles of the five participating agencies in these efforts included:

- CDFG compiled, developed, and analyzed data related to anadromous fisheries habitat and populations. It also led an interagency evaluation of factors affecting anadromous fisheries production at the stream, subbasin and basin levels, identified areas of refugia, and provided recommendations for restoration and monitoring;
- CDF compiled, developed, and analyzed data related to historical land use changes in the watersheds. It also led preparation of reports that synthesize information, findings, and recommendations, and developed a framework for assessing cumulative impacts;
- DOC/CGS compiled, developed, and analyzed data related to the production and transport of sediment. Tasks included baseline mapping of landslides, landslide potential, and instream sediment, as well as an analysis of stream geomorphology and sediment transport;
- NCRWQCB compiled, collected, and analyzed water quality data for the assessment. The assessment included comparison of recently collected and past available information comprised predominately of a robust water temperature data set, and some limited sediment data;

- DWR installed and maintained stream monitoring gages where needed to develop and analyze stream flow information.

Results of assessments conducted by various agency personnel on the Mattole team were brought together in an integrated synthesis process. This process attempts to describe spatial and temporal relationships between watershed and stream conditions and dynamic watershed processes that have been at work to form them. To assist in this process, the team used Geographic Information System (GIS) based watershed data coverage and an Ecological Management Decision Support (EMDS) model to help evaluate watershed conditions and processes.

The EMDS system software (Reynolds 1999) helps evaluate and synthesize information on watershed and stream conditions important to salmonids. The team has constructed “knowledge base” models to identify and evaluate environmental factors that shape anadromous salmonid habitat. Based upon these models, the system performs calculations with available data it is provided. The synthesized results help provide insights about stream and watershed conditions, and their linked relationships.

EMDS offers a number of benefits for the assessment work that the NCWAP is conducting, and also has some known limitations. An April 2002 peer review of the EMDS system recommended some substantial changes to the system to improve its function and utility. Consequently, at the time of this report, we have been able to implement some, but not all of the system’s potential outputs.

Scale of Information

The NCWAP Mattole assessment team subdivided the Mattole Basin into five subbasins for assessment and analyses purposes. These study areas included the Estuary, Northern, Eastern, Southern, and Western Subbasins (Figure 2). In general, each subbasin has somewhat unique attributes that are generally common to the several CalWater 2.2a Planning Watersheds (PWs) contained within a subbasin. These PWs are approximately 3,000-10,000 acres and are used as planning and evaluation units for projects such as Timber Harvest Plans (THP) submitted to CDF. Common PW attributes pertain to a subbasin’s landslide propensity, vegetation, climate, land use, streams, fisheries, towns and communities, access corridors, etc.

Subbasins and their planning watersheds are used as the basis of NCWAP’s GIS analysis upon which various coverages are overlain. They are also used as the basis of the Ecological Management Decision Support system GIS images and analyses.

Assessment Products

This report and its appendices are intended to be useful to landowners, watershed groups, agencies, and individuals to help guide restoration, land use, and management decisions.

NCWAP products include:

- A basin level Geologic Report that includes:
 - Maps of landslides and geomorphic features related to landsliding;
 - Relative landslide potential maps;
 - A map of features indicative of excess sediment production, transport and/or deposition;
 - Maps of stream reaches classified by gradient and relative landslide potential.
- A basin level Synthesis Report that includes:
 - Collection of Mattole Basin historical and sociological information;
 - Description of historic and current vegetation cover and change, land use, geology and fluvial geomorphology, water quality, stream flow, water use, and instream habitat conditions;
 - Hypotheses and evaluation about watershed conditions affecting salmonids;
 - An interdisciplinary analysis of the suitability of stream reaches and the watershed for salmonid production and refugia areas;
 - Tributary and watershed recommendations for management, refugia protection, and restoration activities to address limiting factors and improve conditions for salmonid productivity;

- Monitoring recommendations to improve the adaptive management efforts.
- Ecological Management Decision Support system (EMDS) models to help analyze data;
- Databases of information used and collected;
- A data catalogue and bibliography;
- Web based access to the Program's products: <http://newatershed.ca.gov/>, and <http://imaps.dfg.ca.gov/>.
- A Compact Disk (CD) developed through the Institute for Fisheries Resources (IFR) which uses the Klamath Resources Information System (KRIS).



Figure 2. NCWAP Mattole subbasins and CalWater 2.2a Planning Watersheds.

General Assessment Questions, Conclusions, and Recommendations

The NCWAP Mattole assessment team has utilized the six NCWAP assessment questions (pg. 1) to organize its assessment conclusions and recommendations. The following discussion of the assessment questions and recommendations for improvement activities specific to subbasins, streams, stream reaches, and in some cases potential project sites, are also included in each subbasin section of this report. The CDFG Appendix F to this report contains more specific assessment methods, findings, conclusions, and recommendations for stream and watershed improvements.

Mattole Basin

What are the history and trends of the sizes, distribution, and relative health and diversity of salmonid populations in the Mattole Basin?

Conclusions:

- Historical accounts and stream surveys conducted in the 1960s by CDFG indicate that the Mattole Basin historically supported relatively robust populations of Chinook salmon, coho salmon, and steelhead trout. Fishery surveys have been conducted on many tributaries throughout the Mattole Basin in the last ten years. These biological stream surveys indicate the presence of Chinook salmon and steelhead trout in all five Mattole subbasins and the presence of coho salmon in the Eastern, Southern, and Western Subbasins. Coho salmon also utilize the Estuary Subbasin on their migrations; however, in limited surveys conducted in the Northern Subbasin since the 1980s, coho salmon have not been detected. No studies have been conducted to estimate subbasin or tributary specific population levels of coho salmon or Chinook salmon. However, a nine-year intensive study of three tributaries within the Northern Subbasin indicated stable age classes of steelhead trout. Intensive studies of the Estuary Subbasin have shown depressed populations of over-summering Chinook salmon and steelhead trout, and no coho have been detected. Mattole Basin-wide population estimates indicate depressed meta-populations of Chinook and coho salmon. A metapopulation is a “regional (Mattole Basin) population consisting of semi-isolated local (stream/subbasin) populations” (Levins 1970).

What are the current salmonid habitat conditions in the Mattole Basin? How do these conditions compare to desired conditions?

Conclusions:

- Erosion/Sediment
 - Instream sedimentation in several stream reaches throughout the basin may be approaching or exceeding levels considered unsuitable for salmonid populations. Currently, the estuary is very shallow and lacks channel complexity. Erosion/sediment reduction is the top recommendation category for the Eastern and Estuary subbasins;
- Riparian/Water Temperature
 - High summer water temperatures in many surveyed tributaries are deleterious to summer rearing salmonid populations in the Estuary, Northern, Eastern, and Western Subbasins. Riparian/water temperature improvements is the top recommendation category in the Northern Subbasin;
- Instream Habitat
 - In general, pool habitat, escape and ambush cover, and water depth are unsuitable for salmonids in many mainstem and tributary stream reaches in the Mattole Basin. In the Southern Subbasin summer flow is inadequate or non-existent in many reaches. Large woody debris recruitment potential is poor in the Northern, Eastern, and Western subbasins. Instream habitat improvement is the top recommendation category in the Southern and Western subbasins;
- Gravel/Substrate
 - Available data from sampled streams suggest that suitable, high quality spawning gravel for salmonids is limited in some streams in all subbasins;

- Refugia Areas

Salmonid habitat conditions in the Mattole Basin are generally best in the Southern and Western Subbasins, mixed in the Eastern Subbasin, and worst in the Estuary and Northern subbasins.

- Table 1 summarizes subbasin salmonid refugia conditions:

Table 1. Subbasin salmonid refugia area ratings in the Mattole Basin.

Subbasin	Refugia Categories:				Other Categories:		
	High Quality	High Potential	Medium Potential	Low Quality	Non-Anadromous	Critical Contributing Area/Function	Data Limited
Estuary Subbasin			X			X	X
Northern Subbasin			X				X
Eastern Subbasin			X				X
Southern Subbasin		X					X
Western Subbasin			X				X

Ratings in this table are done on a sliding scale from best to worst. Subbasin refugia ratings are aggregated from their tributary ratings. See page 70 for a discussion of refugia criteria.

What are the relationships of geologic, vegetative, and fluvial processes to natural events and land use history?

Conclusions:

- Geologic units within the basin can be grouped into one of three bedrock terrains (hard, moderate, and soft) and one for Quaternary alluvial units. Larger landslides are more prevalent in soft terrain and are typically earthflows, while smaller slides, typically debris slides, are more prevalent in hard and moderate terrains;
- Weak geologic materials, steep slopes, high rainfall, and strong earthquakes common to the basin result in high rates of natural landsliding and surface erosion, particularly in soft terrain. These natural processes can be exacerbated by human land use within the basin. About one half of the basin is considered to have a high to very high landslide potential;
- In general, the subbasins can be ranked in terms of relative impacts with geologically unstable areas linked to adverse stream effects. The Northern Subbasin has the largest proportion of geologically unstable (soft) terrain, which is linked to the highest amount of historically active landslides, gullies, and stream features indicative of excess sediment production, transport, and storage. The Southern Subbasin has the lowest proportion of geologically unstable terrain, historically active landslides, gullies, and stream features indicative of excess sediment production and transport. The Eastern and Western Subbasins are intermediate between these two extremes due to the variability in the proportion of soft terrain and steep slopes;
- Source and transport reaches of the blue line streams as depicted on NCWAP stream network maps, were identified primarily in bedrock terrains, while response (depositional) reaches were identified in the Quaternary (alluvial) unit reaches. Features indicative of excess sediment production, transport, and storage have decreased throughout most of the basin in the period between 1984 and 2000. The reduction in these features was greatest in the hard terrain. The distribution of these features in bedrock terrains suggests that portions of the areas interpreted as having a high to very high landslide potential are also the sources of sediment that has been delivered to streams;

- Human activities such as timberland conversion to grasslands and brush, grazing, timber harvest, and road construction and use, have interacted with natural geologic instability to increase sediment production above naturally high background levels. Historic timber harvesting and streamside road construction reduced riparian canopy and increased direct sediment inputs and water temperature. Overall, the current landscape is comprised of smaller diameter forest stands than in pre-European times. Decades of fire suppression have created dense forest stands and brush-lands leading to the designation of Mattole Basin population centers as high wildfire threat areas.

How has land use affected these natural processes?

Conclusions:

- Land use, including road construction and use, timber harvesting, and grazing, have added excess sediment to the fluvial system. Many of the effects from these activities are spatially and temporally removed from their upland sources. Excess sediment remains in the Mattole mainstem despite decades of low timber harvesting activity;
- Currently, roads are a major land use contributor of sediment (CDF, 2002). Large storms or other catastrophic events combined with poor road location and construction practices have the potential to deliver large and adverse amounts of sediment into stream systems;
- Water extraction for agriculture, road maintenance, and residential use has the direct effect of reducing the amount of available habitat for fish;
- Large woody debris recruitment potential is limited by the low percentage of near-stream forest stands containing trees in large diameter classes;
- Grazing is widespread on privately owned grasslands and has shifted to cattle from sheep since the enactment of predation protection measures. Stock impacts to streams are not widespread, but watercourse exclusionary fencing is limited.

Based upon these conditions trends, and relationships, are there elements that could be considered to be limiting factors for salmon and steelhead production?

Conclusions:

Based on available information for the Mattole Basin, the NCWAP team believes that salmonid populations are currently being limited by:

- Impacted estuarine conditions;
- General basin-wide lack of habitat complexity;
- High instream sediment levels;
- High summer water temperatures;
- Reduced basin-wide coho and Chinook meta-populations.

What habitat improvement activities would most likely lead toward more desirable conditions in a timely, cost effective manner?

Recommendations:

Flow and Water Quality Improvement Activities:

- Discourage unnecessary and wasteful use of water during summer low flow periods to improve stream surface flows and fish habitat, especially in the Southern Subbasin;
- Increase the use of water storage and catchments systems that collect rainwater in the winter for use in the drier summer season;
- Support local efforts to educate landowners about water storage and catchments systems, and find ways to support and subsidize development of these systems;

- Support and expand ongoing local efforts that monitor summer water and air temperatures on a continuous 24-hour basis to detect long-range trends and short-term effects on the aquatic/riparian community;
- Support efforts to determine the role of sediment in the mainstem Mattole River in elevated estuarine water temperatures.

Erosion and Sediment Delivery Reduction Activities:

- Reduce sediment deposition to the estuary by supporting a basin-wide road and erosion assessment/control program such as the Mattole Restoration Council's *Good Roads, Clear Creeks* effort. Continue to conduct and implement road and erosion assessments such as the ongoing efforts in the Dry and Westlund planning watersheds in the Eastern Subbasin. Expand road assessment efforts because of the potential for further sediment delivery from active and abandoned roads, many of which are in close proximity to stream channels, especially in the Bridge and Thompson planning watersheds in the Southern Subbasin;
- Establish monitoring stations and train local personnel to track in-channel sediment and aggraded reaches throughout the basin and especially in the North Fork Mattole and the Upper North Fork Mattole rivers, Mattole Canyon, Blue Slide, Squaw, Honeydew, and Bear creeks;
- Consider the nature and extent of naturally occurring unstable geologic terrain, landslides and landslide potential (especially Categories 4 and 5, page 89) when planning potential projects in the subbasin;
- At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams. CGS mapping indicates eroding banks are not a significant basin wide issue, but may be of localized importance. They occur in isolated, relatively short reaches distributed throughout the Mattole Basin;
- Based on the high incidence of unstable slopes in the Northern Subbasin, any future sub-division development proposals should be based on an existing county-imposed forty acre minimum parcel sub-division ordinances;
- Encourage the use of appropriate Best Management Practices for all land use and development activities to minimize erosion and sediment delivery to streams. For example, low impact yarding systems should be used in timber harvest operations on steep and unstable slopes to reduce soil compaction, surface disturbance, and resultant sediment yield.

Riparian and Habitat Improvement Activities:

- Where current canopy is inadequate and site conditions, including geology, are appropriate, initiate tree planting and other vegetation management to hasten the development of denser and more extensive riparian canopy, especially in the Northern Subbasin;
- Landowners and managers in the Northern and Western subbasins should work to add more large organic debris and shelter structures to streams in order to improve channel structure, channel function, habitat complexity, and habitat diversity for salmonids;
- Ensure that stream reaches with high quality habitat in the Mattole Basin are protected from degradation. This is especially important in the Southern Subbasin. The best stream conditions as evaluated by the stream reach EMDS were found in the South Fork of Vanauken Creek, Mill Creek - at Mattole river-mile 56.2 (RM 56.2), Stanley Creek, Thompson Creek, Yew Creek, and Lost Man Creek Tributary in the Southern Subbasin, and in Harrow Creek in the Eastern Subbasin. Refugia investigation criteria, which include biological parameters, indicated Bear Creek was the best stream evaluated in the Mattole Basin.

Supplemental Fish Rescue and Rearing Activities:

- Since 1982 a successful cooperative salmonid rearing facility in the Mattole Basin headwaters has been operated by the Mattole Salmon Group (MSG) and CDFG. They also operate a Chinook juvenile out-migrant rescue rearing program near the estuary, which released 2,400 coded-wire-tagged Chinook sub-yearlings in October 2002. These programs should be continued as needed to

supplement wild populations while the improvements from long-term watershed and stream restoration efforts develop;

- Initiate a systematic program to monitor the effectiveness of fish rescue and rearing activities, and determine the need for the continuance of cooperative, supplemental fish rearing efforts;
- Update as scheduled the MSG/CDFG five-year plan that provides guidance to the cooperative rearing and rescue projects. Base the periodic plan updates on the findings of the effectiveness monitoring program and best available science.

Education, Research, and Monitoring Activities:

- Utilize Humboldt State University studies conducted in the early 1990s as baseline information to periodically monitor trends in estuarine conditions and fish production;
- Encourage ongoing stream inventories and fishery surveys of tributaries throughout the Mattole Basin, especially in the Northern Subbasin;
- In order to protect privacy while developing data, the possibility of training local landowners to survey their own streams and to conduct salmonid population status surveys throughout the basin would be advisable;
- Further study to investigate the affects to water quality from timberland herbicide use is recommended;
- Follow the procedures and guidelines outlined by NCRWQCB to protect water quality from ground applications of pesticides;
- Encourage appropriate chemical transportation and storage practices as well as early spill reporting and clean-up procedures;
- Conduct training as needed and desired to assist landowners, managers, consultants, and other interested parties in the construction and appropriate application of landslide occurrence and potential maps from GIS analysis.

Estuary Subbasin

Estuaries normally provide an important transition environment between marine and freshwater environments. They generally provide an abundant and rich food supply and relative isolation from several marine and freshwater predators. Sediment deposition is naturally high in estuaries due to their position at the mouth of rivers and typical low gradient and often restricted outlets. Therefore, excessive erosion rates in a watershed produce negative effects in its estuary.

Key Findings:

- Historical accounts indicate that the Estuary Subbasin supported populations of Chinook salmon, and steelhead trout throughout the summer months, in addition to being a vital transitional step on the seaward migration of juvenile salmonids and the returning spawning migration of adult salmonids. Biological studies were conducted in the estuary in the late 1980s and early 1990s by HSU researchers and the Mattole Restoration Council along with current population counts by the Mattole Salmon Group. These studies indicate that over-summering Chinook salmon and steelhead trout populations in the Estuary Subbasin are currently depressed;
- Instream sediment from both past land use and natural geologic processes upstream has been delivered to the estuary by large storm events, impacting the low gradient estuarine channel. Comparison of 1942 and 1965 photos indicates that the estuary widened, and areas of vegetation were lost during that time frame. However, the 1984 and 2000 aerial photos show some channel narrowing and vegetative improvement during this time period. Whereas dormant landslides, steep terrain and areas with high to very high landslide potential indicate that slopes in the subbasin are susceptible to landsliding and erosion, the bulk of excess instream sediment appears to have been transported from upstream sources;
- Soil disturbance associated with several agricultural and development activities have exacerbated the naturally high levels of sediment delivery to the Mattole River and its tributaries. In particular, vegetation removal and road construction during the post 1950 peak timber harvest period, coupled

with the transport energy of the devastating floods of 1955 and 1964 have created extensive negative stream characteristics in the lower reaches of many large tributaries including mainstem Honeydew Creek. These negative impacts include displaced riparian vegetation; wide, aggraded channels; and very warm summertime water temperatures. These impacts have become resident in the Estuary Subbasin;

- The present state of estuarine habitat is limiting the successful production of salmonids, especially Chinook salmon. Based on known salmonid temperature suitability studies, current sediment, and temperature impacts in the estuary are thought to be deleterious to summer rearing salmonid populations. Results of habitat assessment conducted from 1988 through 1994 in the estuary by Humboldt State University, Mattole Restoration Council, and Mattole Salmon Group researchers identified a critical shortage of adequate pool habitat, water depth, substrate embeddedness, and escape and ambush cover. These are all necessary for survival of salmonids in the critical over-summering life stage;
- Although lack of escape cover for fish increases the risk of predation by birds, mammals, etc., data from other river systems indicate that seal and sea lion predation is usually not limiting to salmonids. These data indicate pinnipeds are not likely to have a large impact on Mattole Basin salmonid runs.

Key Recommendations:

- Continue to support the Mattole Salmon Group's Chinook juvenile rescue rearing and fish-tagging efforts, and incorporate a program to monitor effectiveness;
- Reduce sediment deposition to the estuary by supporting a basin-wide road and erosion assessment/control program such as the Mattole Restoration Council's Good Roads, Clear Creeks effort;
- Avoid potential sedimentation directly into the estuary from the estuary's upland slopes, which are predominantly mélange bedrock and dormant landslides. Encourage the use of appropriate Best Management Practices to achieve this objective;
- Consider the nature and extent of naturally occurring unstable geologic terrain, landslides and landslide potential (especially Categories 4 and 5, page 89) when planning potential projects in the subbasin;
- Maintain and enhance existing riparian cover. Use cost share programs and conservation easements as appropriate;
- Support ongoing local efforts that monitor summer water and air temperatures on a continuous 24-hour basis to detect long-range trends and short-term effects on the aquatic/riparian community;
- Support efforts to determine the role of the mainstem Mattole River in elevated estuarine water temperatures;
- Utilize Humboldt State University studies conducted in the early 1990s as baseline information to periodically monitor trends in estuarine conditions and fish production;
- Protect instream flows in Mill Creek (RM 2.8) and Stansberry Creek for thermal refugia;
- It would be informative to further study the degree to which the cool, summer base flow from Mill Creek (RM 2.8) could temper the warmer mainstem Mattole River waters and provide an area of cool water refugia. To do so, a summer low flow connection between Mill Creek and the river would have to be established through the Mattole's gravel floodplain.

Northern Subbasin

The Northern Subbasin is located between the estuary and Honeydew Creek at river mile 26.5 (RM 26.5) along the northeastern side of the Mattole mainstem. Almost 99% of the subbasin is privately owned and it is largely managed for timber production and cattle ranching. The town of Petrolia is located in this subbasin near the confluence of the North Fork Mattole and Mattole rivers. The Northern Subbasin supports populations of Chinook salmon and steelhead trout.

Key Findings:

- Historical accounts and stream surveys conducted in the 1960s by CDFG indicate that the Northern Subbasin supported populations of Chinook salmon, coho salmon, and steelhead trout. Fishery surveys have been conducted on very few tributaries in the Northern Subbasin in the last ten years. Therefore, current fish population information is poor. However, existing recent biological stream surveys indicate the presence of healthy steelhead trout populations but an absence of coho salmon. Mattole Basin-wide data indicate a depressed population of Chinook salmon, which likely indicates a depressed number of Chinook salmon spawners in the Northern Subbasin;
- Erosion/Sediment
 - Instream sedimentation in several stream reaches in this subbasin may be approaching or exceeding levels considered unsuitable for salmonid populations. Macroinvertebrate data indicate fair to good or good conditions. However, amphibians sensitive to fine sediment were absent from most stream reaches surveyed in this subbasin;
- Riparian/Water Temperature
 - High summer water temperatures in surveyed streams are deleterious to summer rearing salmonid populations in this subbasin;
- Instream Habitat
 - In general, Northern Subbasin pool habitat, escape and ambush cover, water depth, and substrate embeddedness are unsuitable for salmonids. Large woody debris recruitment potential is very poor overall;
- Gravel Substrate
 - Available data from sampled streams suggest that suitable amounts and distribution of high quality spawning gravel for salmonids is lacking in this subbasin;
- There is a lack of stream survey and water chemistry information for much of the Northern Subbasin;
- This subbasin has the most structurally disrupted and least stable geology in the basin, with approximately 43% of the area underlain by soft terrain. Correspondingly, more than half of the total area occupied by historically-active landslides and gully lengths mapped in the basin are located in the Northern Subbasin. Due to the prevalence of soft terrain with its associated high level of active landslides and gully erosion, it appears that comparatively high rates of natural sedimentation are to be expected in this subbasin;
- Stream channels in this subbasin have the greatest total length of features indicative of excess sediment production, transport and storage within the basin, with the smallest reduction in these features observed between 1984 and 2000;
- Grasslands are extensive in the Northern Subbasin, occupying 31% of the area. Grasslands are commonly associated with soft terrain. As a result of past timber harvest and conversion activities, 40% of the Northern Subbasin is occupied by small diameter (twelve to twenty-four inches diameter at breast height) forest stands. Only 7% is in forest stands greater than twenty-four inches. The most significant vegetation change in recent years was the result of two 1990 wildfires burning 10% of the subbasin, primarily in the Oil Creek and Camp Mattole planning watersheds;
- Over 99% of this subbasin is privately owned and is managed for timber production and grazing. Current timber harvesting is concentrated on industrial timberland subject to both the California Forest Practice Rules and a Habitat Conservation Plan. Existing road location and densities primarily reflects construction related to timber harvest access since the 1940s;
- Based on information available for the Northern Subbasin, the NCWAP team believes that salmonid populations are currently being limited by high water temperatures, high sediment levels, and reduced habitat complexity in the subbasin.

Key Recommendations:

- Encourage more stream inventories and fishery surveys of tributaries within this subbasin;
- In order to protect privacy while developing data, the possibility of training local landowners to survey their own streams and conduct salmonid population status surveys should be developed;
- Several years of monitoring summer water and air temperatures to detect trends using continuous, 24 hour monitoring thermographs should be done. Continue temperature monitoring efforts in the North Fork Mattole River, Sulphur Creek, and the Upper North Fork Mattole River, and expand efforts into other subbasin tributaries. Study the role of seeps and springs as cold water refugia in Oil and Rattlesnake creeks;
- Where current canopy is inadequate and site conditions, including geology, are appropriate, initiate tree planting and other vegetation management to hasten the development of denser and more extensive riparian canopy. Low canopy density measurements were found in Conklin, Oil, Green Ridge, Devils, and Rattlesnake creeks;
- Maintain and enhance existing riparian cover. Use cost share programs and conservation easements as appropriate;
- Landowners and managers in this subbasin should be encouraged to add more large organic debris and shelter structures in order to improve channel structure, channel function, habitat complexity, and habitat diversity for salmonids. Pool shelter has the lowest suitability for salmonids in Sulphur Creek Tributary #1, Conklin, and Green Ridge creeks;
- Establish monitoring stations and train local personnel to track in-channel sediment and aggraded reaches throughout the subbasin and especially in the lower reaches of the North Fork Mattole River and the Upper North Fork Mattole River;
- Consider the nature and extent of naturally occurring unstable geologic terrain, landslides and landslide potential (especially Categories 4 and 5, page 89) when planning potential projects in the subbasin;
- Encourage the use of appropriate Best Management Practices for all land use and development activities to minimize erosion and sediment delivery to streams. For example, low impact yarding systems should be used in timber harvest operations on steep and unstable slopes to reduce soil compaction, surface disturbance, and resultant sediment yield;
- Based on the high incidence of unstable slopes in this subbasin, any future sub-division development proposals should be based on existing county-imposed forty acre minimum parcel sub-division ordinances;
- At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams. CDFG stream surveys indicated Sulphur Creek, Sulphur Creek Tributaries 1 and 2, Conklin Creek, Oil Creek, and the lower reaches of the North Fork Mattole River have bank stabilization activities as a top tier tributary improvement recommendation. Rattlesnake, McGinnis, Green Ridge, and Devils creeks also have eroding banks mapped by CGS. These could be of localized importance to reduce stream fine sediment levels;
- Continue efforts such as road erosion proofing, improvements, and decommissioning throughout the basin to reduce sediment delivery to the Mattole River and its tributaries. CDFG stream surveys indicated Sulphur Creek and Sulphur Creek Tributary #1 have road sediment inventory and control as a top tier tributary improvement recommendation.

Eastern Subbasin

The Eastern Subbasin is located between Honeydew Creek (RM 26.5) and Bridge Creek (RM 52.1) along the eastern side of Wilder Ridge, and the Mattole mainstem above Bear Creek, for a distance of about 25.6 miles. Over 94% of the subbasin is privately owned and it is largely managed for timber production and cattle ranching. The Eastern Subbasin supports populations of Chinook salmon, coho salmon, and steelhead trout.

Key Findings:

- No studies have examined the size or health of salmonid populations in the Eastern Subbasin. However, historical accounts and stream surveys conducted in the 1960s by CDFG indicate that the Eastern Subbasin supported populations of Chinook salmon, coho salmon, and steelhead trout. Recent biological stream surveys indicate the presence of steelhead trout throughout the Eastern Subbasin and coho salmon in a few tributaries. Low salmonid populations throughout the Mattole Basin indicate that salmonid populations in the Eastern Subbasin are likely to be depressed at this time;
- Erosion/Sediment
 - Instream sedimentation in several stream reaches in this subbasin may be approaching or exceeding levels considered unsuitable for salmonid populations. Macroinvertebrates were not sampled in this subbasin. Amphibian sensitive to fine sediment were absent from all stream reaches surveyed in this subbasin;
- Riparian/Water Temperature
 - Available data from sampled streams suggest that high summer temperatures are deleterious to summer rearing salmonid populations in the lower depositional reaches of most streams in this subbasin;
- Instream Habitat
 - In general, a high incidence of shallow pools, a lack of cover, and a lack of large woody debris have contributed to a simplification of instream salmonid habitat.
- Gravel Substrate
 - Available data from sampled streams suggest that suitable amounts and distribution of high quality spawning gravel for salmonids is lacking in this subbasin;
- Gilham, Harrow, Eubank, McKee, and Painter creeks are considered good refugia.
- In April 2000, a serious diesel spill occurred directly into a subbasin tributary. Petroleum spills represent a chemical threat to favorable stream conditions and should be eliminated using all means available;
- Geologic conditions in this subbasin are the most variable in the basin. Areas of relatively intact and stable geologic units are locally interrupted by areas of highly disrupted and unstable soft terrain. These are accompanied by active landslides, gully erosion and, in proximal stream channels, features indicative of excess sediment production, transport and storage in the streams;
- Although stream conditions in bedrock reaches suggest that in 1984 this subbasin had the second highest level of impact within the basin, these conditions have improved dramatically in the period between 1984 and 2000. Considering the low degree of impact by features indicative of excess sediment production, transport and storage observed in the adjacent upstream Southern Subbasin, it appears that the stream features observed in the Eastern Subbasin must be derived either internally within the subbasin or from the adjacent Western Subbasin;
- As a result of past timber harvest and conversion activities, 56% of the Eastern Subbasin is populated with small diameter forest stands (twelve to twenty-four inches diameter at breast height). Twenty-one percent is in forest stands greater than twenty-four inches. Grasslands occupy 11% of the area;
- Over 94% of this subbasin is privately owned. Much of it was sub-divided after extensive timber harvesting. Currently, there is a low level of timber harvest activity;
- Existing road densities and locations reflect construction for timber harvest access since the 1940s. Many of these roads are now used to access homes or parcels;
- Based on information available for the Eastern Subbasin, the NCWAP team believes that salmonid populations are currently being limited by high sediment levels, high water temperatures, reduced habitat complexity, and embedded spawning gravels in some tributaries of the Eastern Subbasin. Harrow Creek has very good salmonid habitat; Westlund, Gilham, Gilham Creek Tributary, Sholes,

Little Grindstone, Harrow, Eubank, McKee, McKee Creek Tributary, and Painter creeks have good canopy density; and Painter Creek has good cobble embeddedness.

Key Recommendations:

- Establish monitoring stations and train local personnel to track in-channel sediment and aggraded reaches throughout the subbasin and especially in Mattole Canyon and Blue Slide creeks;
- At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams. CDFG stream surveys indicate Middle, Westlund, Gilham, Gilham Creek Tributary, North Fork Fourmile, Sholes, Harrow, Little Grindstone, Grindstone, Eubank, and McKee creeks, and the Tributary to McKee Creek have bank stabilization activities as a top tier tributary improvement recommendation. These could be of localized importance to reduce stream fine sediment levels;
- Continue to conduct and implement road and erosion assessments such as the ongoing efforts in the Dry and Westlund planning watersheds. Initiate road improvements and erosion proofing throughout the subbasin to reduce sediment delivery. Middle, Westlund, Gilham, Gilham Creek Tributary, Sholes, Blue Slide, and Fire creeks had road sediment inventory and control as one of their top tier tributary improvement activity recommendations;
- Several years of monitoring summer water and air temperatures to detect trends using continuous, 24 hour monitoring thermographs should be done. Continue temperature monitoring efforts in Dry, Middle, Westlund, Sholes, Mattole Canyon, Blue Slide, Eubank, Gilham, and Grindstone creeks. Start temperature monitoring in Little Grindstone, Fire, and Box Canyon creeks;
- Where current canopy is inadequate and site conditions, including geology, are appropriate, use tree planting and other vegetation management techniques to hasten the development of denser and more extensive riparian canopy. Canopy density has the lowest suitability for salmonids in Dry and Blue Slide creeks;
- Landowners and managers in the this subbasin should work to add more large organic debris and shelter structures in order to improve channel structure, channel function, habitat complexity, and habitat diversity for salmonids. Pool shelter has the lowest suitability for salmonids in Dry, Middle, Westlund, Gilham Creek Tributary, Fourmile, North Fork Fourmile, Grindstone, Little Grindstone, Blue Slide, McKee Creek Tributary, and Painter creeks;
- Consider the nature and extent of naturally occurring unstable geologic terrain, landslides and landslide potential (especially Categories 4 and 5, page 89) when planning potential projects in the subbasin;
- Encourage the use of appropriate Best Management Practices for all land use and development to minimize erosion and sediment delivery to streams;
- Encourage appropriate chemical transportation and storage practices, early spill reporting, and clean-up procedures.
- Ensure that high quality habitat within this subbasin is protected from degradation. The highest stream reach conditions as evaluated by the stream reach EMDS and refugia analysis were found in the Gilham, Harrow, Eubank, McKee, and Painter Creeks.

Southern Subbasin

The Southern Subbasin is located south of Bridge Creek (RM 52.1) and McKee Creek (RM 52.8), both near Thorn Junction, and continues upstream to the Mattole's headwaters near Four Corners (RM 61.5), a distance along the mainstem Mattole of about 9.4 miles. The subbasin is 86% privately owned and is largely managed for timber production and rural subdivision. The Southern Subbasin supports populations of Chinook salmon, coho salmon, and steelhead trout. Except for dewatered channels and low flows in summer, this subbasin currently contains the best salmonid habitat in the Mattole Basin.

Key Findings:

- Dewatered stream channels are a serious problem during summer low flow periods in the mainstem Mattole River and select reaches of many tributaries;

- No systematic, scientific studies have examined the size or health of salmonid populations in the Southern Subbasin. However, historical accounts and stream surveys conducted in the 1960s by CDFG indicate that the Southern Subbasin supported populations of Chinook salmon, coho salmon, and steelhead trout. Recent biological stream surveys indicate the presence of steelhead trout and coho salmon throughout the Southern Subbasin. This subbasin supports coho salmon in more tributaries than the other Mattole subbasins. Low salmonid populations throughout the Mattole Basin indicate that salmonid populations in the Southern Subbasin are also likely to be depressed at this time.
- Erosion/Sediment
 - As indicated by the Potential Stream Sediment Production EMDS, potential fine sediment delivery to streams due to road runoff is high in the Southern Subbasin. Although there are few roads on unstable slopes, there are many roads positioned low on hill slopes and many road crossings of streams throughout the Bridge Creek and Thompson Creek Planning Watersheds. The types and variety of macroinvertebrates indicate fair to good, good, or good to excellent instream conditions. Additionally, amphibians sensitive to fine sediment were present in several stream reaches surveyed in this subbasin;
- Riparian/Water Temperature
 - Available data suggest that summer water temperatures support rearing juvenile salmonid populations in most reaches of most streams with summer flow in this subbasin;
- Instream Habitat
 - Based upon 26 miles of surveyed stream habitat in the past 10 years, the Southern Subbasin is considered to contain some of the best salmonid habitat in the Mattole Basin. The utility of this good habitat for salmonids is compromised because of summer de-watering of the upper mainstem reach and many subbasin tributaries;
- Gravel Substrate
 - Available data from sampled streams suggest that suitable amounts and distribution of high quality spawning gravel for salmonids is lacking in some subbasin stream reaches;
- Most creeks in this subbasin are considered good refugia;
- The geologic conditions in the Southern Subbasin are the most uniform and stable in the Mattole Basin. Nearly all the hillside areas are underlain by hard terrain. Correspondingly, this subbasin has the lowest density of mapped landslides, and stream channels within the Mattole Basin, and is the least impacted by features indicative of excess sediment production, transport and storage in the basin;
- Redwood stands occur in this subbasin because of favorable conditions, including summer fog. As a result of past timber harvest and conversion activities, over 60% of the Southern Subbasin is occupied by small diameter (twelve to twenty-four inches diameter at breast height) forest stands. Another 22% is in forest stands greater than twenty-four inches. Industrial timberlands on the eastern side of the subbasin have been intensively managed in the past decade and are characterized by young, even-aged conifer stands;
- This is the most densely populated area in the Mattole Basin. Many of the landowners have conservation easements as a part of Sanctuary Forest. Roads, abandoned after early timber harvest activities, are being upgraded and stormproofed by landowners. Many of these roads are now used as residential and parcel access roads and are located near streams.

Key Recommendations:

- Encourage reducing the unnecessary and wasteful use of water to improve summer stream surface flows and fish habitat;
- Increase the use of water storage and catchment systems that collect rainwater in the winter for use in the drier summer season;
- Support local efforts to educate landowners about water storage and catchment systems, and to find ways to subsidize development of these systems;

- Ensure that this high quality habitat is protected from degradation. The highest stream reach conditions as evaluated by the stream reach EMDS and refugia analysis were found in the Bridge, West Fork Bridge, South Fork West Fork Bridge, South Fork of Vanauken, Mill (RM 56.2), Stanley, Baker, Thompson, Yew, and Lost Man creeks, the Upper Mattole River, and Lost Man Creek Tributary;
- Improve the culvert on Stanley Creek that is blocking juvenile salmonids from accessing high quality rearing habitat;
- Establish monitoring stations and train local personnel to track in-channel sediment and aggraded reaches throughout the subbasin and especially in Bridge and Thompson creeks;
- Consider the nature and extent of naturally occurring unstable geologic terrain, landslides and landslide potential (especially Categories 4 and 5, page 89) when planning potential projects in the subbasin;
- Encourage the use of appropriate Best Management Practices for all land use and development activities to minimize erosion and sediment delivery to streams. For example, low impact yarding systems should be used in timber harvest operations on steep and unstable slopes to reduce soil compaction, surface disturbance, and resultant sediment yield;
- Expand road assessment efforts because of the potential for further sediment delivery from active and abandoned roads, many of which are in close proximity to stream channels;
- Continue efforts such as road improvements, and decommissioning throughout this subbasin to reduce sediment delivery to the Mattole River and its tributaries. CDFG stream surveys indicated South Fork Vanauken Creek, the Upper Mattole River, Stanley Creek, Thompson Creek, and Yew Creek have road sediment inventory and control as a top tier tributary recommendation. In 2002, road erosion assessments and road erosion control projects were underway in the upper Mattole Basin;
- Further study of timberland herbicide use is recommended;
- Follow the procedures and guidelines outlined by NCRWQCB to protect water quality from ground applications of pesticides;
- A cooperative salmonid rearing facility exists in the headwaters, operated since 1982 by the Mattole Salmon Group. This operation has been successful and should be continued on an as needed basis in order to supplement wild populations of Chinook salmon;
- Initiate a training program for local landowners to survey their own streams and monitor salmonid populations. This will provide important data and protect privacy;
- Monitor summer water and air temperatures to detect trends using continuous 24 hour monitoring thermographs. Continue temperature monitoring efforts in Bridge, Vanauken, Baker, Yew, Thompson, Helen Barnum, Lost Man, Dream Stream, and Ancestor creeks, and expand efforts into other subbasin tributaries.

Western Subbasin

The Western Subbasin lies between the little Bear Creek in the estuary (RM 0.3) and the headwaters of the South Fork of Bear Creek (RM 50) along the western side of the Mattole mainstem and Wilder Ridge for a distance of about sixty miles. The subbasin is largely managed by BLM for conservation and recreation in the King Range National Conservation Area, which comprises 47% of the subbasin. The Western Subbasin supports populations of Chinook salmon, coho salmon, and steelhead trout.

Key Findings:

- No systematic, scientific studies have examined the size or health of salmonid populations in the Western Subbasin. However, historical accounts and stream surveys conducted in the 1960s by CDFG indicate that the subbasin supported populations of Chinook salmon, coho salmon, and steelhead trout. Recent biological stream surveys indicate the presence of steelhead trout throughout the subbasin and coho salmon in a few tributaries. Low salmonid populations throughout the Mattole Basin indicate that salmonid populations in the Western Subbasin are also likely to be

depressed at this time. However, populations have a good chance to recover due to public land stewardship that is actively engaged in improving watershed and stream conditions. In addition, salmonid rearing activities within the subbasin are working to supplement native stocks as habitat conditions improve;

- Erosion/Sediment
 - Instream sediment in several stream reaches in this subbasin may be approaching or exceeding levels considered unsuitable for salmonid populations. Macroinvertebrates data indicate good conditions. Additionally, amphibians sensitive to fine sediment were present in most stream reaches surveyed in this subbasin;
- Riparian Water Temperature
 - Available data suggest high summer temperatures are deleterious to summer rearing salmonid populations in some streams in this subbasin; in others it is good;
- Instream Habitat
 - In-stream habitat diversity and complexity, based on available survey data (i.e. pool depths, cover, and large woody debris) may be adequate for salmonid production. Additionally, recent surveys indicate instream habitat appears to be improving. Large woody debris recruitment potential is poor in this subbasin;
- Gravel Substrate
 - Available data from sampled streams suggest that suitable amounts and distribution of high quality spawning gravel for salmonids is lacking in some reaches in this subbasin;
- The upper reaches of Bear, Mill (RM 2.8), North Fork Bear, South Fork Bear, Big Finley, and South Fork Big Finley creeks, and the tributary to North Fork Bear Creek, are considered good refugia, and this will continue due to BLM and cooperative private land owners and current management policies in key headwater reaches. In fact, Bear Creek was the only creek in the Mattole Basin determined to provide high quality refugia.
- Although the Western Subbasin encompasses the dramatic relief of the King Range, with the highest proportion of steep slopes in the basin, approximately half of the subbasin is underlain by hard terrain and it is second only to the Southern Subbasin in terms of stable areas. Slope instability is focused primarily in the abundant areas with steep to very steep slopes and the limited area of soft terrain;
- Based on features indicative of excess sediment production, transport and storage, the pattern of impacts to stream conditions is similar to that observed in the Eastern Subbasin, and is highly variable throughout the subbasin. Considering the low degree of impact by features indicative of excess sediment production, transport and storage observed in the adjacent upstream Southern Subbasin, it appears that the stream features observed in the Western Subbasin must be derived either internally within the subbasin or from the adjacent Eastern Subbasin;
- As a result of past timber harvest and conversion activities, almost 60% of the Western Subbasin is occupied by small diameter (twelve to twenty-four inches diameter at breast height) forest stands. Another 20% is in forest stands greater than twenty-four inches;
- Forty square miles, or nearly half of this subbasin are in public ownership managed by the Bureau of Land Management as part of the King Range National Conservation Area, designated as late seral reserve. Timber harvesting has occurred on less than one percent of the area in the last ten years and has been at low levels for decades. Privately owned acres carrying grassland are grazed while smaller, residential parcels are concentrated along the main county roads. Old roads, many abandoned, are common across the landscape;
- Based on information available for this subbasin, the NCWAP team believes that salmonid populations are currently being limited by reduced habitat complexity, high sediment levels, high water temperatures, and embedded spawning gravels.

Key Recommendations:

- Based upon the latest science on placement of large woody debris in stream channels, managers in the Western Subbasin should work to improve channel structure and function for salmonids. Pool shelter has the lowest suitability for salmonids in Mill Creek (RM 2.8) Tributary #1 and South Fork Big Finley Creek;
- Establish monitoring stations and train local personnel to track in-channel sediment and aggraded reaches throughout the subbasin and especially in the lower reaches of major tributaries and Squaw, Honeydew, Finley, Big Finley, Woods and Bear creeks;
- Continue efforts such as road improvements and decommissioning throughout the basin to reduce sediment delivery to the Mattole River and its tributaries. Road inventories have been completed for much of this planning basin, and it is recommended that this effort be continued until a complete inventory is compiled. CDFG stream surveys indicated Mill Creek (RM 2.8) and Bear Trap Creek have road sediment inventory and control as a top tier tributary improvement recommendation;
- Monitor summer water and air temperatures to detect trends using continuous 24 hour monitoring thermographs. Continue temperature monitoring efforts in Stansberry, Mill (RM 2.8) Clear, Squaw, Woods, Honeydew, Bear, North Fork Bear, South Fork Bear, Little Finley, Big Finley, and Nooning creeks, and expand efforts into other subbasin tributaries;
- Ensure that near stream forest projects retain and recruit high canopy densities in riparian areas to reduce solar radiation and moderate air temperatures;
- Where current canopy is inadequate and site conditions, including geology, are appropriate, use tree planting and other vegetation management techniques to hasten the development of denser and more extensive riparian canopy. Canopy density has the lowest suitability for salmonids in Squaw Creek. Use cost share programs and conservation easements as appropriate;
- The three cooperative salmon rearing facilities in this subbasin should be continued as needed to supplement wild populations while the improvements from long-term watershed and stream restoration efforts develop;
- Initiate a systematic program to monitor the effectiveness of these fish rescue and rearing activities, and determine the need for the continuance of cooperative, supplemental fish rearing efforts on an ongoing, adaptive basis using the best available science;
- The nature and extent of naturally occurring unstable geologic terrain, landslides and landslide potential (especially Categories 4 and 5, page 89) must be considered when planning potential projects in the subbasin;
- Encourage the use of appropriate Best Management Practices for all land use and development to minimize erosion and sediment delivery to streams;
- In order to protect privacy on private lands in this subbasin while developing data, the possibility of training local landowners to survey streams and conduct salmonid population status surveys is advisable;
- Ensure that high quality habitat within this subbasin is protected from degradation. The highest stream reach condition as evaluated by the stream reach EMDS and refugia analysis were found in Bear, Mill (RM 2.8), North Fork Bear, South Fork Bear, Big Finley, and South Fork Big Finley creeks and the tributary to North Fork Bear Creek.

Summary of Subbasin Conditions and Recommendations

Table 2. Summary of Mattole subbasins stream and watershed conditions and recommended action.

	Estuary Subbasin	Northern Subbasin	Eastern Subbasin	Southern Subbasin	Western Subbasin
Identified Conditions					
In-Stream Sediment	-/R	-/R	-	-/R	-
Water Temperature	-	-	~	+	~
Pools	-	-	-	~	-
Flow	+	~	~	-	~
Escape Cover	-	-	-	-	-
Fish Passage Barriers	+	~	~	~	~
Natural Sediment Sources	-	-	~	+	+
Management-Related Sediment Sources	-	-	+	-	+
Recommended Improvement Activity Focus Areas					
Flow				X	
Erosion/Sediment		X	X	X	X
Riparian/Water Temperature	X	X	X		X
Instream Habitat	X	X	X	X	X
Gravel/Substrate			X	X	X
Fish Passage Barriers				X	X

- + Condition is favorable for anadromous salmonids
- Condition is not favorable for anadromous salmonids
- ~ Condition is mixed or indeterminate for anadromous salmonids
- R Trend indicates improved conditions 1984-2000
- X Recommended improvement activity focus areas

Propensity for Improvement

Advantages

The Mattole Basin has several advantages for planning and implementing successful salmonid habitat improvement activities that include:

- An active restoration community made up of many highly skilled and experienced individuals. This community includes the comprehensive Mattole River and Range Partnership. The Partnership is composed of several natural resources agencies, Mattole landowners, and watershed groups like the Mattole Salmon Group and the Mattole Restoration Council. This broad base provides a common forum for different points of view and interests concerning the watershed and fisheries within the basin;
- Skilled fundraisers who are capable of recruiting funds from a myriad of grant programs. Currently, a major grant was secured by members of the Partnership from the Coastal Conservancy for a multi-year general watershed improvement program which includes various activities ranging from education to stream work;
- A skilled workforce with a core of experienced workers. This group of community based technicians provides a resource for ensuring successful projects and building future technical capacity in the basin. The logical long range product of this component is better watershed stewardship on a landscape scale;
- An expanding group of cooperative landowners that includes both public and private landowners from all subbasins in the Mattole. The effect of this growing cooperative land-base is the ability to choose locations for projects where the best result can be achieved in the shortest period of time. This accelerates the overall effectiveness of the watershed improvement program. The current Good Roads, Clear Creeks program is an example of this advantage;

- Several watersheds and streams are now well into recovery and should respond well to continued stewardship and improvement treatments.
- This NCWAP assessment containing findings, conclusions, and recommendations for improvement opportunities. This report provides focus from the basin scale, through the subbasin scale and down to the level of specific tributary assessments. With this tool to focus project design efforts, local landowners and restoration groups can pursue the mutual development of site specific improvement projects on an adaptive basis;
- A core population of Chinook salmon, coho salmon, and steelhead trout as well as summer steelhead unique to the Mattole River system. Although depressed from historic levels there remain local stocks that can take advantage of improved conditions. Over time, barring overwhelming outside impacts, the stocks should grow in response to watershed efforts. Currently, efforts by the Cooperative Hatchbox and Rescue Rearing Program are augmenting these core populations.

Challenges

The Mattole Basin also has some challenges confronting efforts to improve watershed and fish habitat conditions, and increase anadromous fish populations:

- Not all landowners are interested in salmonid habitat improvement efforts. Without a watershed wide cooperative land-base, treatment options are limited. In some cases this can remove some key areas from consideration of project development;
- High natural erosion rates will always be a part of the Mattole landscape. These high background erosion thresholds makes the need to reduce human induced erosion rates to as close to zero as possible an imperative;
- Summer and early fall water resources are very limited in some very important parts of the basin, particularly the Southern Subbasin. The very good instream habitat conditions in that subbasin are of no use to fish without water in the streams. As human water use intensifies, the loss of critical fish stocks will continue and compromise other fishery improvement efforts.
- The risk of pollutant spills also becomes problematic with increases in near stream residential and agricultural development and occupation.
- Even if needed watershed improvement efforts succeed in reducing sediment yield to basin streams, the estuary will be slow respond. The scale of the problem and the nature of low gradient, depositional reaches to move sediment slowly cause this situation. Therefore, containing the erosion that exceeds natural background levels will affect estuarine habitat improvements only over a very long period of time. That means basin wide sediment reduction efforts will have to be sustained with a great deal of patience for a very long time, in fact, in perpetuity. Meanwhile, salmonid stocks impacted by the harsh estuarine conditions will have to be protected and perhaps rescued until conditions improve. Fish rescue is a very difficult and risky task and can be problematic itself.
- Chinook and coho salmon and summer steelhead meta-populations are currently reduced to levels that could impact the amount of needed straying of colonizing fish into improved or expanded habitat conditions. Without a high degree of habitat seeding from strays, meta-population increases are compromised and the desired response to improvement efforts are slowed, successes masked, and evaluation difficult.

Conclusion

The likelihood that any North Coast basin will react in a responsive manner to management improvements and restoration efforts is a function of existing watershed conditions. In addition, the status of processes influencing watershed conditions will affect the success of watershed improvement activities. A good knowledge base of these current watershed conditions and processes is essential for successful watershed improvement. Acquiring this knowledge requires property access. Access is also needed to design, implement, monitor, and evaluate suitable improvement projects. This systematic process is dependent upon the cooperative attitude of resource agencies, watershed groups and individuals, and landowners and managers.

The Mattole NCWAP assessment has considered a great deal of available information regarding watershed conditions and processes in the Mattole Basin. This long assessment and analysis has identified problems and made recommendations to address these problems while considering the advantages and challenges of conducting watershed improvement programs in the Mattole Basin.

After considering these problems, recommendations, advantages and challenges, the Mattole Basin appears to be a very good candidate for a successful long term programmatic watershed improvement effort.

According to the current NCWAP refugia analysis, the Mattole Basin has medium to high potential to become a high quality refugia habitat basin. Reaching this goal is dependent upon the formation of a well organized and thoughtful improvement program founded on a broad based community commitment to active watershed stewardship. The energy and opportunity appears to be present here, and well underway in many parts of the basin. If these efforts are pursued vigorously and patiently, one day the Mattole could once again be known as “clear waters” and be home to both a healthy fishery resource and a healthy watershed-based community in a uniquely diverse and beautiful area.

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